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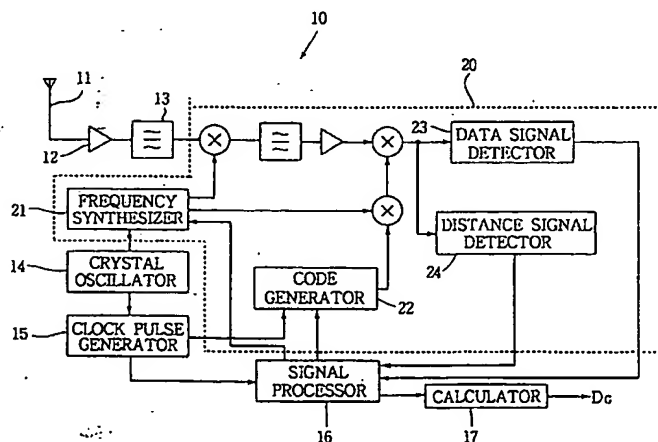
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(54) **System for detecting an altitude of a vehicle dependent on a global positioning system.**

(57) When detecting altitudes the situation may arise where it is determined that an altitude (H) of a vehicle can not be calculated from data applied from satellites. When such a calculation can not be performed, a provisional altitude is obtained with the following equation:

$$H = (1 - \alpha) H_G + \alpha H_0$$

where  $H_G$  is an altitude obtained by the GPS,  $H_0$  is a reference altitude obtained by outside means, and  $\alpha$  ( $0 < \alpha < 1$ ) is a predetermined smoothing coefficient.

**FIG.1****EP 0 606 890 A1**

On the other hand, B' is a point representing a GPS altitude  $H_G(n-1)$  detected by the last four-satellite detection, and A' is a point representing a GPS altitude  $H_G(n-2)$  at the time before last.

The altitude difference  $\Delta H_0$  between reference altitudes  $H_p(n-1)$  and  $H_p(n-2)$  points B and A is

$$\Delta H_0 = H_p(n-1) - H_p(n-2).$$

The altitude difference between GPS altitudes  $H_G(n-1)$  and  $H_G(n-2)$  is equal to the difference  $\Delta H_0$ .

Therefore, the altitude  $H_{Gn}$  at the point C can be obtained as follows:

$$H_{Gn} = H_G(n-1) + \Delta H_0.$$

Explaining the operation with reference to Fig. 8, when the three-satellite detection is performed (step 82),  $\Delta H_0$  is calculated at a step 83. The height  $H_{Gn}$  is calculated at a step 84, and the position is calculated at a step 85.

Referring to Fig. 9 showing the seventh embodiment, the embodiment is to obtain the height at the point B of Fig. 7. At a step 93, the position of the point A is calculated. The height  $H_G(n-1)$  at the point B is calculated as a step 95.

The embodiment of Fig. 10 is the combination of the sixth embodiment of Fig. 8 and the fifth embodiment of Fig. 6.

The embodiment of Fig. 11 is the combination of the embodiment of Fig. 9 and the embodiment of Fig. 6.

While the presently preferred embodiments of the present invention have been shown and described, it is to be understood that these disclosures are for the purpose of illustration and that various changes and modifications may be made without departing from the scope of the invention.

## Claims

1. A system for detecting an altitude (H) of a vehicle dependent on a global positioning system (GPS) comprising:
  - determining means for determining that the altitude (H) can not be calculated from data received and applied from satellites (11, 12, 13) and for producing a provisional calculation demand;
  - calculating means (15, 16, 17, 22) responsive to the provisional calculation demand for calculating a provisional altitude by correcting a GPS altitude obtained by the GPS at a last time and a reference altitude ( $H_0$ ) obtained by outside means with a smoothing coefficient ( $\alpha$ ).
2. A system for detecting an altitude (H) of a vehicle dependent on a global positioning sys-

tem (GPS) comprising:

determining means for determining that the altitude (H) can not be calculated from data received and applied from satellites (11, 12, 13) and for producing a provisional calculation demand;

calculating means (15, 16, 17, 22) responsive to the provisional calculation demand for calculating a provisional altitude by adding a difference between reference altitudes ( $\Delta H_0$ ) obtained before to a GPS altitude obtained by the GPS.

3. The system according to claim 1 wherein: said outside means comprise a memory storing altitude data.
4. The system according to claim 1 or 3 wherein: said calculation is performed on the basis of the following equation:

$$H = (1 - \alpha) H_G + \alpha H_0$$

where  $H_G$  is an altitude obtained by the GPS,  $H_0$  is a reference altitude obtained by the outside means, and  $\alpha$  ( $0 < \alpha < 1$ ) is a pre-determined smoothing coefficient.